A REVIEW BASED RESTAURANT RECOMMENDATION SYSTEM

PROBLEM STATEMENT

Now a days the competition for restaurant business is increasing due to vast number of restaurants which are providing the best quality for users. Here the quality of restaurant includes food and drink, atmosphere, place and service. The reviews which are taken from the dataset will be classified and it will determine the feedback as positive or negative or of users. The reviews can be anything which is related to the food, staff and overall review of the restaurant. This will analyze the restaurant reviews and presents useful information without considering the ratings. In this we will be using the machine learning algorithms with NLP techniques to classify the reviews in proper aspects and performing a sentiment analysis on them. The main benefit of this classification results is to recommend for users to choose the best restaurant.

DATASET DESCRIPTION

- The dataset consist of restaurants and their reviews.
- Understanding the columns in dataset.

User_id: every user is given with a particular id , so that we don’t have confusion among the users.

Place_id: every restaurant is given with unique id even, so that even if the restaurant name repeated we can easily identify.

Restaurant: name of the restaurant. City, state, country : tells us about the address of restaurant.

Food price : this column is regarding the price of items in a restaurant like medium ,high or low.

Smoking area : this tells about whether we can smoke in the restaurant or not, if yes is there any separate space for smoking.

Restaurant cuisine : the special cuisine present in the restaurant.

User budget: by this column we can know the amount that can be spent according to his financial status.

User cuisine : this column is for the users favourite cuisine.

Reviews : these are the comments given for a restaurant given by the user.

```
# IMPORTING ALL THE REQUIRED PACKAGES
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import OneHotEncoder
from textblob import TextBlob
plt.style.use('fivethirtyeight')
import nltk
from nltk.stem import WordNetLemmatizer
from sklearn import neighbors
from scipy import optimize
import math
from sklearn.metrics import accuracy_score,confusion_matrix,classification_report
from sklearn.linear_model import LogisticRegression
from sklearn import metrics
from wordcloud import WordCloud, STOPWORDS
import warnings
warnings.filterwarnings('ignore')
```

```
df = pd.read_csv("/content/restaurant_review_starting.csv")
df.head(10)
```

	user_id	place_id	restaurant_name	city	state	country	food_price	smoking_area	restaurant_cuisine	user_budget	u
0	U1077	P135085	Tortas Locas Hipocampo	San Luis Potosi	San Luis Potosi	Mexico	medium	not permitted	Spanish	medium	
1	U1077	P135038	Restaurant la Chalita	San Luis Potosi	San Luis Potosi	Mexico	medium	section	Italian	medium	
2	U1077	P132825	puesto de tacos	San Luis Potosi	San Luis Potosi	Mexico	low	none	Latin_American	medium	
3	U1077	P135060	Restaurante Marisco Sam	San Luis Potosi	San Luis Potosi	Mexico	medium	none	Mexican	medium	
4	U1068	P135104	vips	NaN	NaN	NaN	medium	not permitted	Fast_Food	low	
5	U1068	P132740	Carreton de Flautas y Migadas	Cd Victoria	Tamaulipas	Mexico	low	permitted	Mexican	low	
6	U1068	P132663	tacos abi	Victoria	Tamaulipas	Mexico	low	none	Burgers	low	(
7	U1068	P132732	Taqueria EL amigo	Cd Victoria	Tamaulipas	Mexico	low	none	Dessert-Ice_Cream	low	

PREPROCESSING

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1161 entries, 0 to 1160
Data columns (total 13 columns):
 #   Column              Non-Null Count  Dtype  
---  ------              --------------  -----  
 0   user_id             1161 non-null   object 
 1   place_id            1161 non-null   object 
 2   restaurant_name     1161 non-null   object 
 3   city                1050 non-null   object 
 4   state               1036 non-null   object 
 5   country             991 non-null    object 
 6   food_price          1161 non-null   object 
 7   smoking_area        1161 non-null   object 
 8   restaurant_cuisine  1107 non-null   object 
 9   user_budget         1119 non-null   object 
 10  user_cuisine        1161 non-null   object 
 11  reviews             1161 non-null   object 
 12  classification      0 non-null      float64
dtypes: float64(1), object(12)
memory usage: 118.0+ KB
```

```
df.describe()
```

```
     classification
```

```
len(df)
```

```
  1161
```

Here in this data as no numerical data present, there are no outliers

```
     25%              NaN
```

```
df.isnull().sum()
```

```
  user_id                 0
  place_id                0
  restaurant_name         0
  city                  111
  state                 125
  country               170
  food_price              0
  smoking_area            0
  restaurant_cuisine     54
  user_budget            42
  user_cuisine            0
  reviews                 0
  classification       1161
  dtype: int64
```

```
a = df['city'].mode()
```

```
c = a[0]
```

```
c = str(c)
```

```
missed_city = df['city'].isnull()
```

```
for i,item in enumerate(df['city']):
  if missed_city[i]:
    df['city'][i]=c
```

```
df.isnull().sum()
```

```
  user_id                 0
  place_id                0
  restaurant_name         0
  city                    0
  state                 125
  country               170
  food_price              0
  smoking_area            0
  restaurant_cuisine     54
  user_budget            42
  user_cuisine            0
  reviews                 0
  classification       1161
  dtype: int64
```

```
a1 = df['state'].mode()
c1 = a1[0]
c1 = str(c1)
missed_state = df['state'].isnull()
for i,item in enumerate(df['state']):
  if missed_state[i]:
    df['state'][i]=c1
```

```
a2 = df['country'].mode()
c2 = a2[0]
c2 = str(c2)
missed_country = df['country'].isnull()
for i,item in enumerate(df['country']):
  if missed_country[i]:
    df['country'][i]=c2
```

```
a3 = df['restaurant_cuisine'].mode()
c3 = a3[0]
c3 = str(c3)
missed_cusine = df['restaurant_cuisine'].isnull()
```

```
for i,item in enumerate(df['restaurant_cuisine']):
  if missed_cusine[i]:
    df['restaurant_cuisine'][i]=c3
```

```
a4 = df['user_budget'].mode()
c4 = a4[0]
c4 = str(c4)
missed_cusine = df['user_budget'].isnull()
for i,item in enumerate(df['user_budget']):
  if missed_cusine[i]:
    df['user_budget'][i]=c4
```

```
a5 = df['smoking_area'].mode()
c5 = a5[0]
c5 = str(c5)
missed_cusine = df['smoking_area'].isnull()
for i,item in enumerate(df['smoking_area']):
  if missed_cusine[i]:
    df['smoking_area'][i]=c5
```

```
df.isnull().sum()
```

```
user_id                  0
place_id                 0
restaurant_name          0
city                     0
state                    0
country                  0
food_price               0
smoking_area             0
restaurant_cuisine       0
user_budget              0
user_cuisine             0
reviews                  0
classification        1161
dtype: int64
```

LABEL ENCODING

FOOD_PRICE :

- 0 : HIGH
- 1 : LOW
- 2 : MEDIUM

SMOKING_AREA :

- 0 : NONE
- 1 : NOT PERMITTED
- 2 : ONLY AT BAR
- 3 : PERMITTED
- 4 : SECTION

USER_BUDGET :

- 0 : HIGH
- 1 : LOW
- 2 : MEDIUM

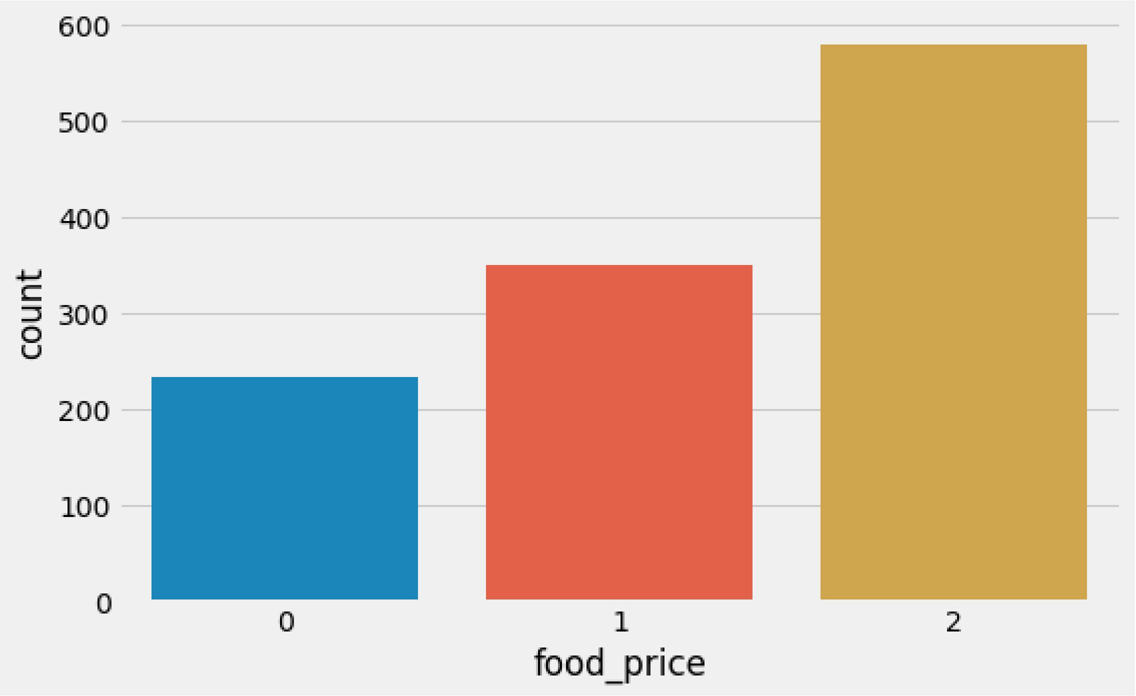
```
le = LabelEncoder()
df['food_price']=le.fit_transform(df['food_price'])
df['smoking_area']=le.fit_transform(df['smoking_area'])
df['user_budget']=le.fit_transform(df['user_budget'])
df.head(5)
```

	user_id	place_id	restaurant_name	city	state	country	food_price	smoking_area	restaurant_cuisine	user_budget	user_c
0	U1077	P135085	Tortas Locas Hipocampo	San Luis Potosi	San Luis Potosi	Mexico	2	1	Spanish	2	An
1	U1077	P135038	Restaurant la Chalita	San Luis Potosi	San Luis Potosi	Mexico	2	4	Italian	2	M
2	U1077	P132825	puesto de tacos	San Luis Potosi	San Luis Potosi	Mexico	1	0	Latin_American	2	M

VISUALISATION

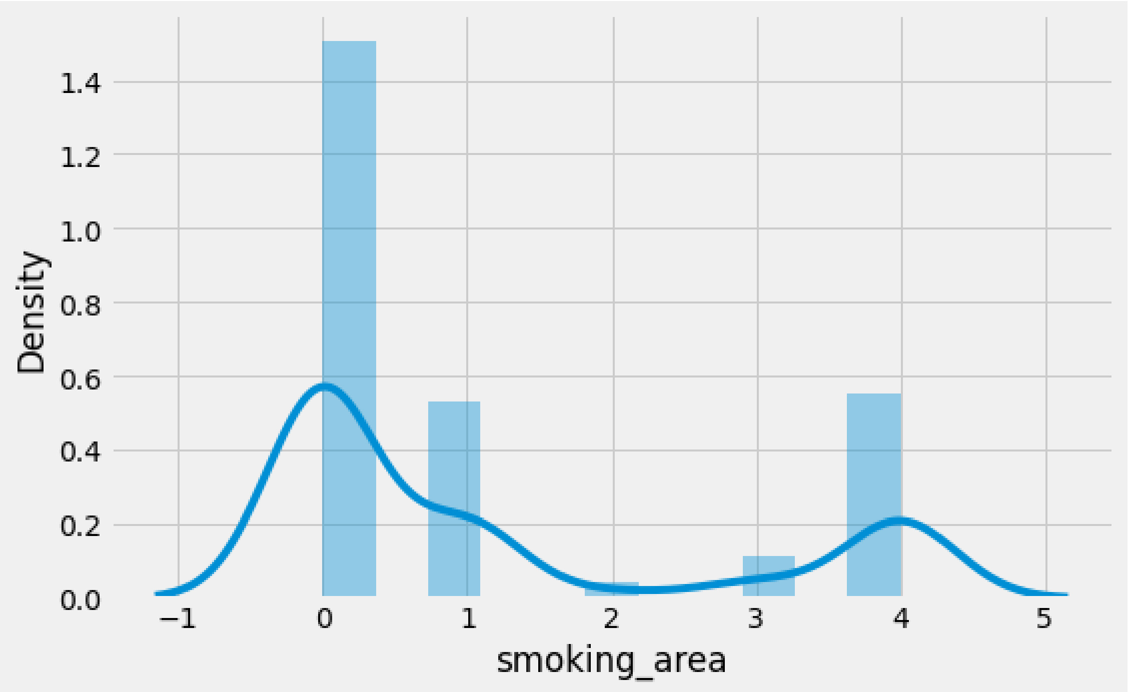
```
plt.figure(figsize = (8,5))
sns.countplot(df['food_price'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e086fd190>
```



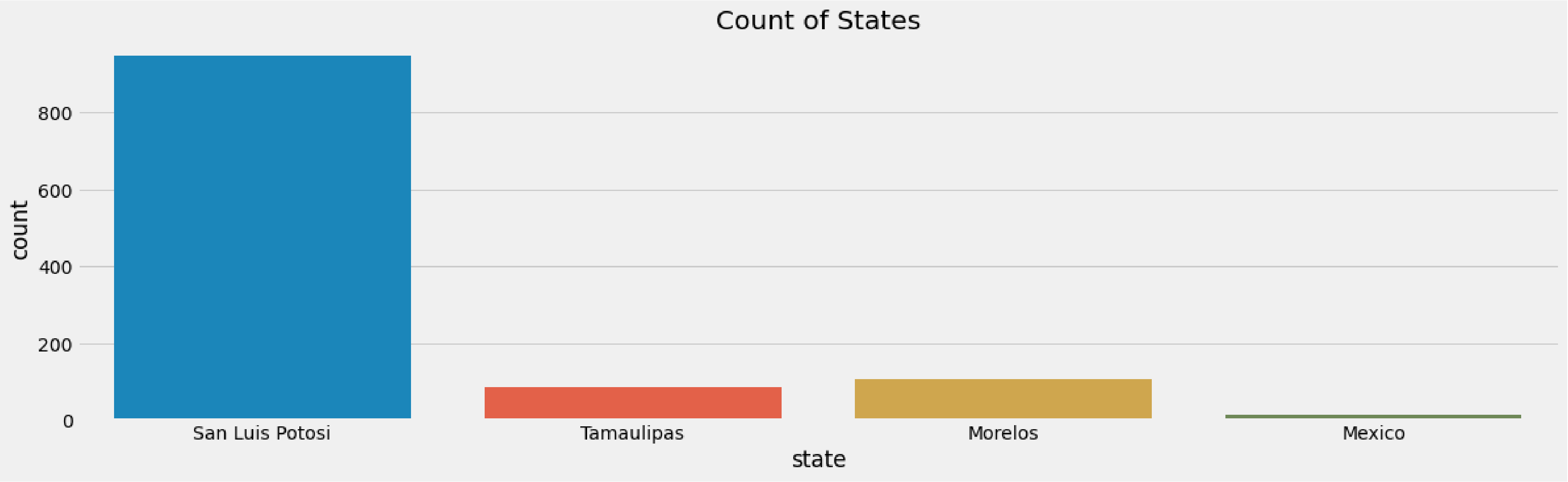
```
plt.figure(figsize=(8,5))
sns.distplot(df['smoking_area'])
df['smoking_area'].skew()
```

```
1.0163440202588883
```



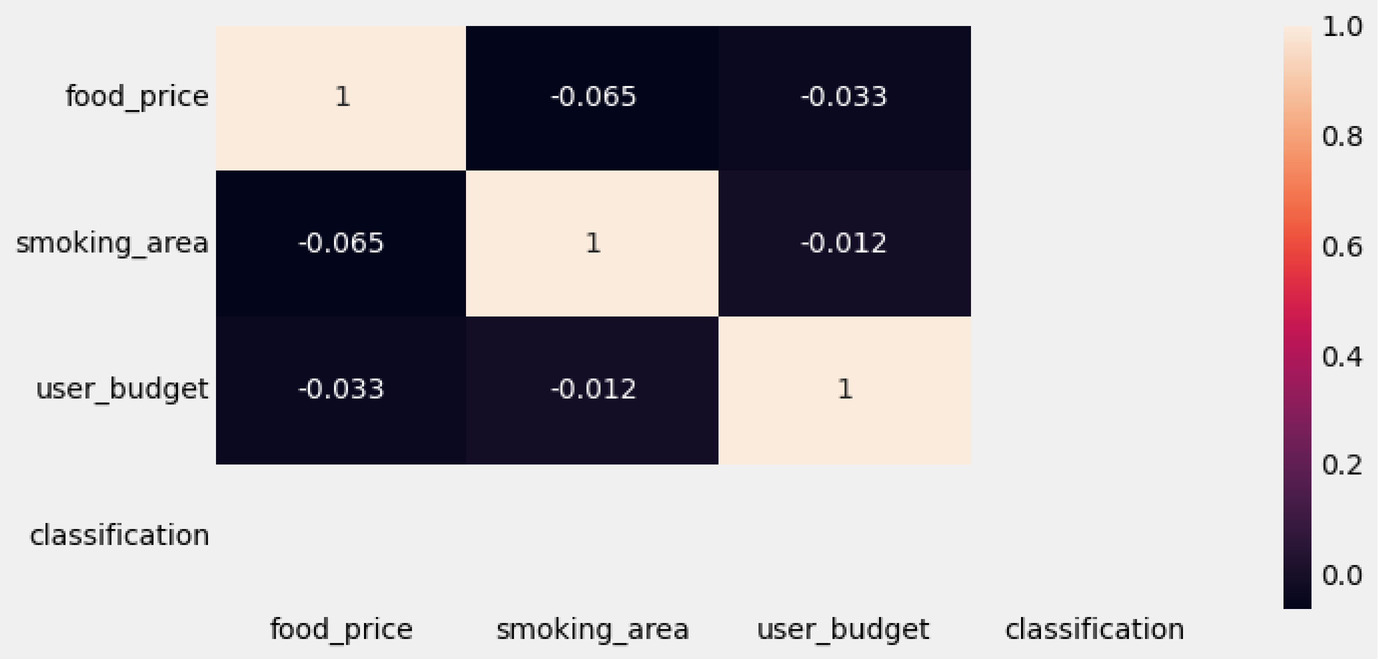
```
plt.figure(figsize=(18,5))
sns.countplot(df['state'])
plt.title('Count of States')
```

```
Text(0.5, 1.0, 'Count of States')
```



```
plt.figure(figsize=(10,5))
fig = df.corr()
sns.heatmap(fig, annot=True)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e085ae7d0>
```

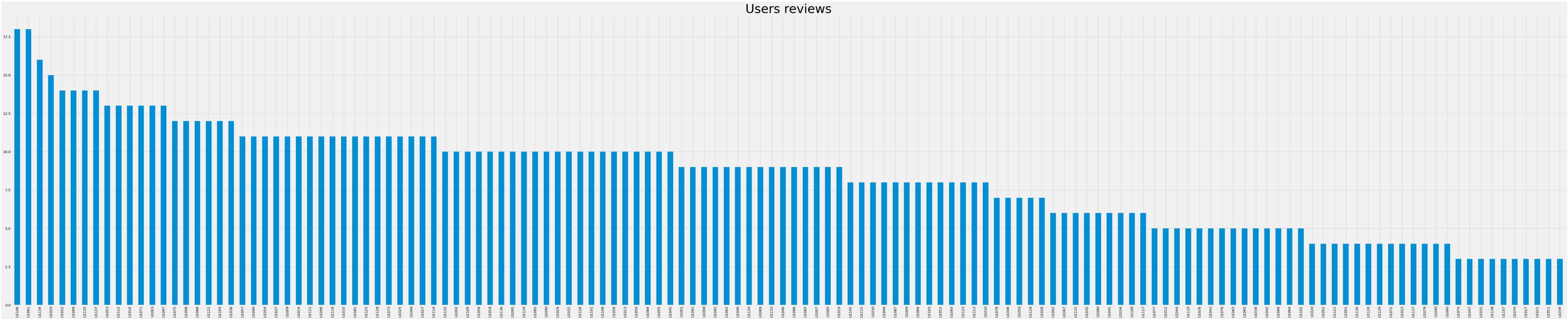


```
cnt = df['user_id'].unique()
k= len(cnt)
k
```

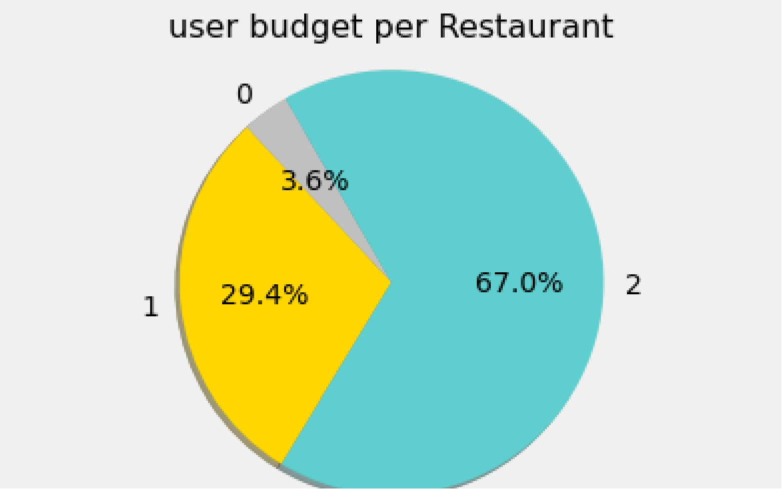
```
138
```

```
plt.figure(figsize=(100,20))
a = plt.title('Users reviews', fontsize=50)
df['user_id'].value_counts().head(k).plot.bar(a)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e084c99d0>
```



```
x = df.groupby('user_budget').agg('count')
labels = x.country.sort_values().index
sizes= x.restaurant_name.sort_values()
colors = ['silver','gold','#5ECECF']
plt.pie(sizes, labels=labels, colors=colors, autopct="%1.1f%%", shadow=True, startangle=120)
plt.axis('equal')
plt.title("user budget per Restaurant", fontsize=16)
plt.show()
```



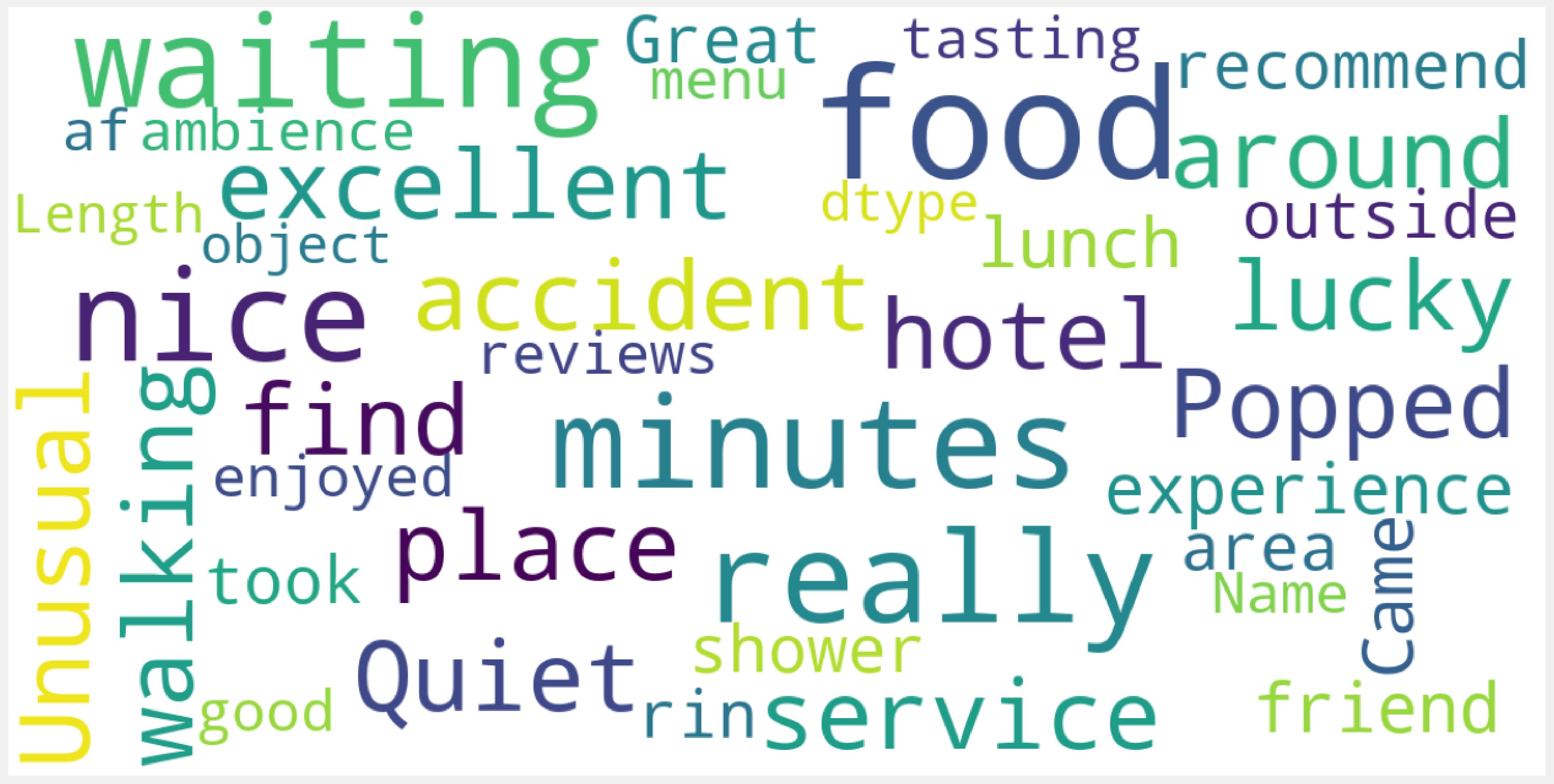
```
stopwords = set(STOPWORDS)

def MyWordcloud(data,title=None):
    wordcloud = WordCloud(
        background_color='white',
        stopwords=stopwords,
        max_words=20000,
        max_font_size=40,
        scale = 3,
        random_state = 1
    ).generate(str(data))

    fig = plt.figure(1, figsize=(20,20))
    plt.axis('off')

    plt.imshow(wordcloud)
    plt.show()

MyWordcloud(df['reviews'].dropna())
```



SENTIMENT ANALYSIS

```
missed_state = df['classification'].isnull()
for i,item in enumerate(df['reviews']):
  y = item
  edu=TextBlob(y)
  x = edu.sentiment.polarity
  if x<0:
      c1 = "Negative"
```

```
elif x==0:
    c1 = "Neutral"
else:
    c1 = "Positive"
if missed_state[i]:
  df['classification'][i]=c1
```

```
df
```

1	U1077	P135038	Restaurant la Chalita	San Luis Potosi	San Luis Potosi	Mexico	2	4	Italian	2
2	U1077	P132825	puesto de tacos	San Luis Potosi	San Luis Potosi	Mexico	1	0	Latin_American	2
3	U1077	P135060	Restaurante Marisco Sam	San Luis Potosi	San Luis Potosi	Mexico	2	0	Mexican	2
4	U1068	P135104	vips	San Luis Potosi	San Luis Potosi	Mexico	2	1	Fast_Food	1
...	...	...	...	...	...	...	...	...	...	..
1156	U1043	P132630	palomo tec	Victoria	Tamaulipas	Mexico	1	0	Italian	2
1157	U1011	P132715	tacos de la estacion	San Luis Potosi	San Luis Potosi	Mexico	1	0	International	2
1158	U1068	P132733	Little Cesarz	Ciudad Victoria	Tamaulipas	Mexico	2	1	Mexican	1
1159	U1068	P132594	tacos de barbacoa enfrente del Tec	San Luis Potosi	San Luis Potosi	Mexico	1	1	American	1
1160	U1068	P132660	carnitas mata calle Emilio Portes Gil	Victoria	Tamaulipas	Mexico	1	0	Seafood	1

1161 rows × 13 columns

```
df['polarity'] = df['reviews'].apply(lambda x: TextBlob(x). sentiment)
#applt textblob sentiment to yelp text column
#and assign it to a new column named polarity
sentiment_series = df['polarity'].tolist()

df[['polaarity','subjectivity']]=pd.DataFrame(sentiment_series,
       index=df.index)
df.drop('polarity', inplace=True, axis=1)

```

```
df
```

1	U1077	P135038	Restaurant la Chalita	San Luis Potosi	San Luis Potosi	Mexico	2	4	Italian	2
2	U1077	P132825	puesto de tacos	San Luis Potosi	San Luis Potosi	Mexico	1	0	Latin_American	2
3	U1077	P135060	Restaurante Marisco Sam	San Luis Potosi	San Luis Potosi	Mexico	2	0	Mexican	2
4	U1068	P135104	vips	San Luis Potosi	San Luis Potosi	Mexico	2	1	Fast_Food	1
...	...	...	...	...	...	...	...	...	...	..
1156	U1043	P132630	palomo tec	Victoria	Tamaulipas	Mexico	1	0	Italian	2
1157	U1011	P132715	tacos de la estacion	San Luis Potosi	San Luis Potosi	Mexico	1	0	International	2
1158	U1068	P132733	Little Cesarz	Ciudad Victoria	Tamaulipas	Mexico	2	1	Mexican	1
1159	U1068	P132594	tacos de barbacoa enfrente del Tec	San Luis Potosi	San Luis Potosi	Mexico	1	1	American	1
1160	U1068	P132660	carnitas mata calle Emilio Portes Gil	Victoria	Tamaulipas	Mexico	1	0	Seafood	1

1161 rows × 15 columns

```
df.to_csv("/content/restaurant_review_preprocessed_data.csv",index=False)
```

MODELS

```
# READING THE PREPROCESSED CSV FILES
df1 = pd.read_csv("/content/restaurant_review_preprocessed_data.csv")
df1.head(5)
```

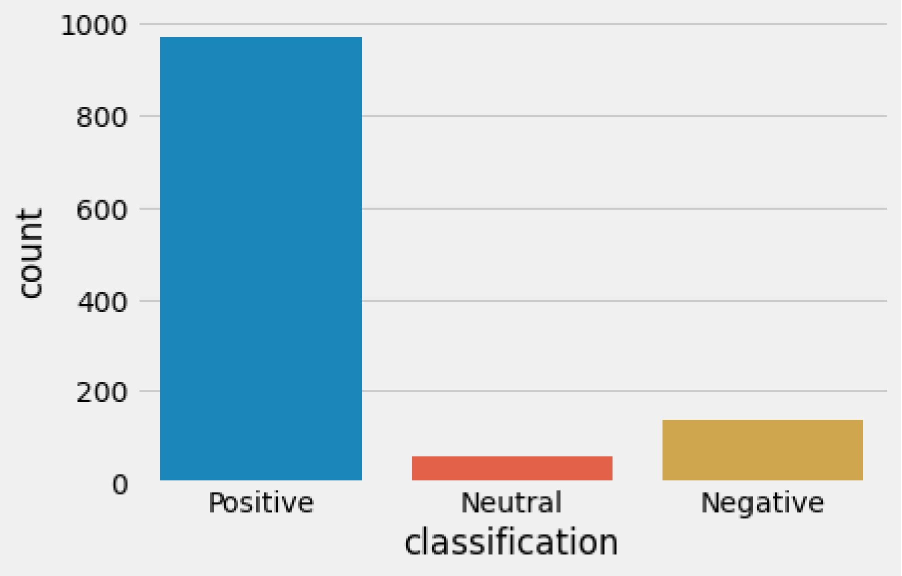
	user_id	place_id	restaurant_name	city	state	country	food_price	smoking_area	restaurant_cuisine	user_budget	user_c
0	U1077	P135085	Tortas Locas Hipocampo	San Luis Potosi	San Luis Potosi	Mexico	2	1	Spanish	2	An
1	U1077	P135038	Restaurant la Chalita	San Luis Potosi	San Luis Potosi	Mexico	2	4	Italian	2	M
2	U1077	P132825	puesto de tacos	San Luis Potosi	San Luis Potosi	Mexico	1	0	Latin_American	2	M
3	U1077	P135060	Restaurante Marisco Sam	San Luis Potosi	San Luis Potosi	Mexico	2	0	Mexican	2	
4	U1068	P135104	vips	San Luis Potosi	San Luis Potosi	Mexico	2	1	Fast_Food	1	Bre

```
df1.shape
```

```
(1161, 15)
```

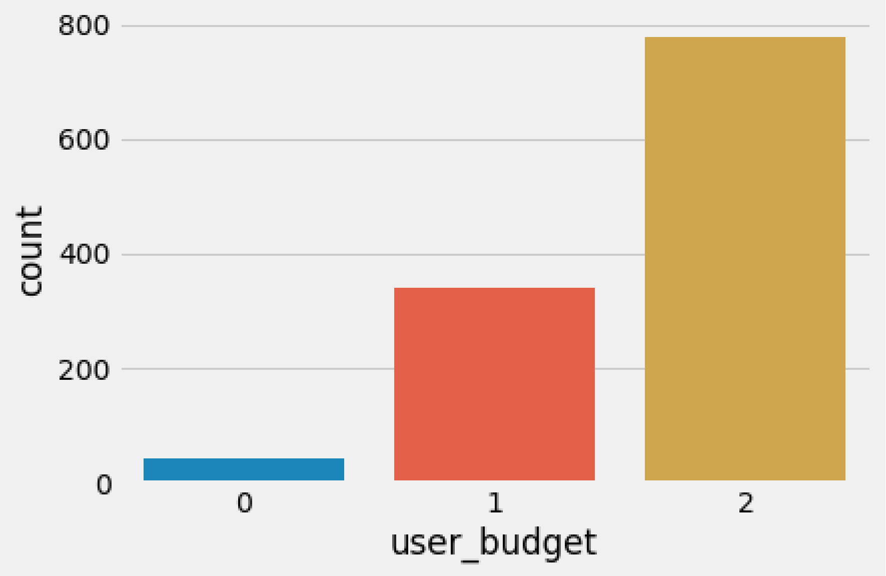
```
sns.countplot(x="classification",data=df1)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e07cd29d0>
```



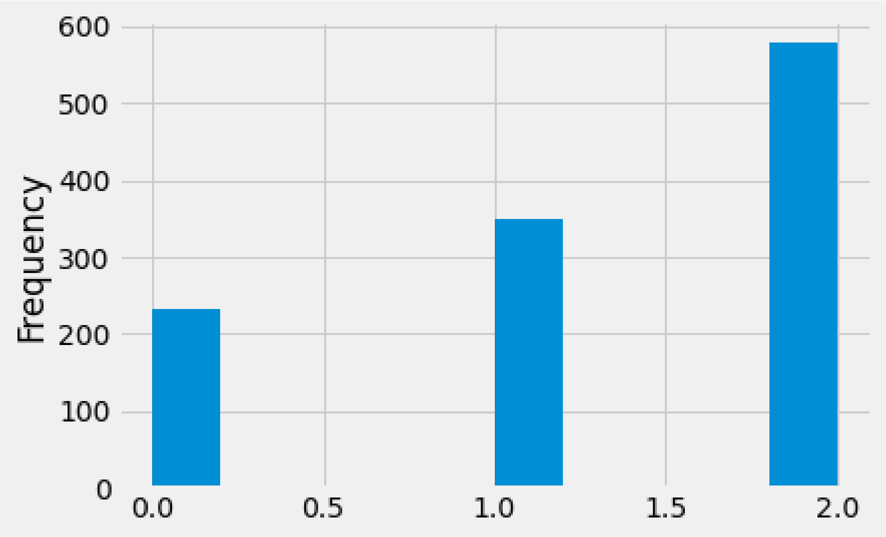
```
sns.countplot(x="user_budget",data=df1)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e07c6d710>
```



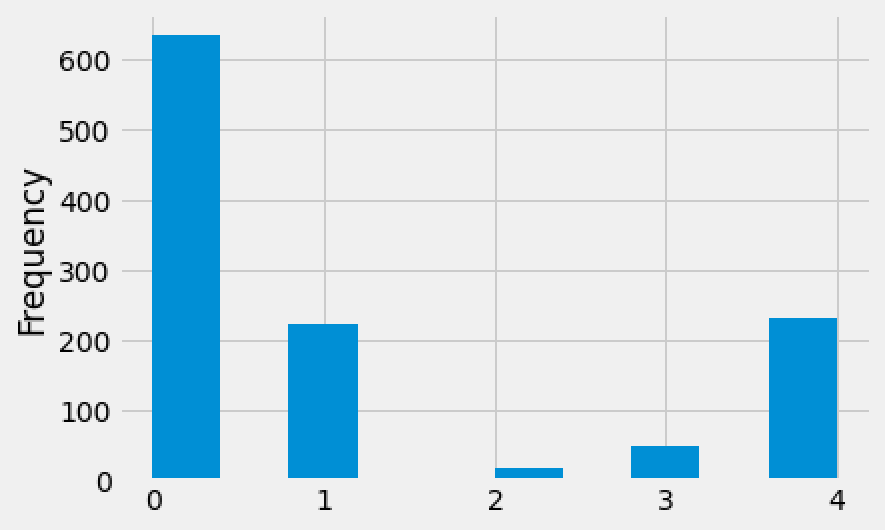
```
df1["food_price"].plot.hist()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e07c2b250>
```



```
df1["smoking_area"].plot.hist()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e07b8f250>
```



```
df1.dtypes
```

```
user_id               object
place_id              object
restaurant_name       object
city                  object
state                 object
country               object
food_price             int64
smoking_area           int64
restaurant_cuisine    object
user_budget            int64
user_cuisine          object
reviews               object
classification        object
polaarity            float64
subjectivity         float64
dtype: object
```

```
df1.isnull().sum()
```

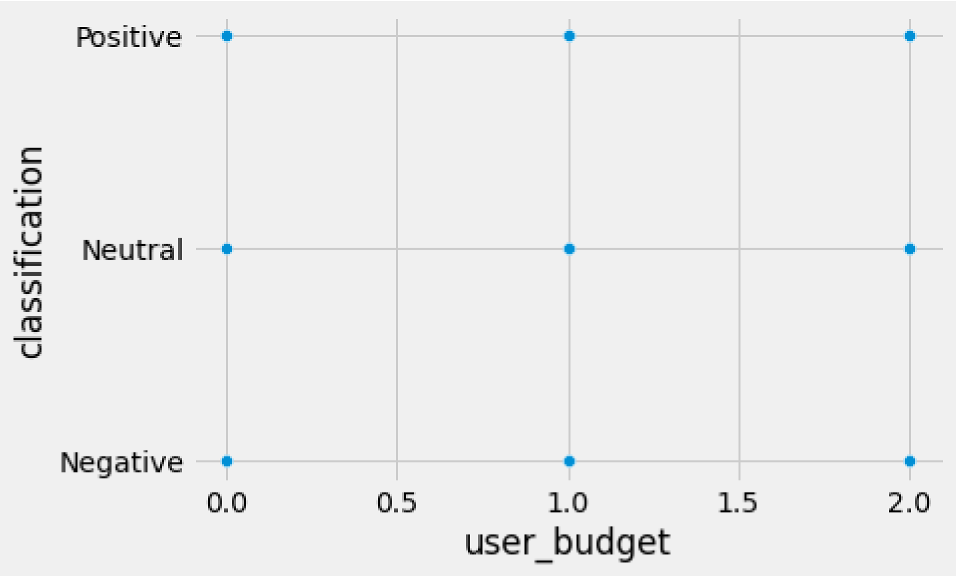
```
user_id               0
place_id              0
restaurant_name       0
city                  0
state                 0
country               0
food_price            0
smoking_area          0
restaurant_cuisine    0
user_budget           0
user_cuisine          0
reviews               0
classification        0
polaarity             0
subjectivity          0
dtype: int64
```

```
df1.head(5)
```

	user_id	place_id	restaurant_name	city	state	country	food_price	smoking_area	restaurant_cuisine	user_budget	user_c
0	U1077	P135085	Tortas Locas Hipocampo	San Luis Potosi	San Luis Potosi	Mexico	2	1	Spanish	2	An
1	U1077	P135038	Restaurant la Chalita	San Luis Potosi	San Luis Potosi	Mexico	2	4	Italian	2	M
2	U1077	P132825	puesto de tacos	San Luis Potosi	San Luis Potosi	Mexico	1	0	Latin_American	2	M
3	U1077	P135060	Restaurante Marisco Sam	San Luis Potosi	San Luis Potosi	Mexico	2	0	Mexican	2	
4	U1068	P135104	vips	San Luis Potosi	San Luis Potosi	Mexico	2	1	Fast_Food	1	Bre

```
sns.scatterplot(x='user_budget', y='classification', data=df1)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6e07abffd0>
```



```
df1.columns
```

```
Index(['user_id', 'place_id', 'restaurant_name', 'city', 'state', 'country',
       'food_price', 'smoking_area', 'restaurant_cuisine', 'user_budget',
       'user_cuisine', 'reviews', 'classification', 'polaarity',
       'subjectivity'],
      dtype='object')
```

```
from sklearn.preprocessing import LabelEncoder
labelencoder  = LabelEncoder()
df1['classification'] = labelencoder.fit_transform(df1['classification'])
df1['user_id'] = labelencoder.fit_transform(df1['user_id'])
df1['place_id'] = labelencoder.fit_transform(df1['place_id'])
df1['restaurant_name'] = labelencoder.fit_transform(df1['restaurant_name'])
df1['city'] = labelencoder.fit_transform(df1['city'])
df1['state'] = labelencoder.fit_transform(df1['state'])
df1['country'] = labelencoder.fit_transform(df1['country'])
df1['restaurant_cuisine'] = labelencoder.fit_transform(df1['restaurant_cuisine'])
df1['user_cuisine'] = labelencoder.fit_transform(df1['user_cuisine'])
df1['reviews'] = labelencoder.fit_transform(df1['reviews'])

```

```
x = df1[['user_id', 'place_id', 'restaurant_name', 'city', 'state', 'country',
       'food_price', 'smoking_area', 'restaurant_cuisine', 'user_budget',
       'user_cuisine', 'reviews','polaarity','subjectivity']]
y = df1['classification']
```

```
x
```

	user_id	place_id	restaurant_name	city	state	country	food_price	smoking_area	restaurant_cuisine	user_budget	user_
0	76	123	94	5	2	1	2	1	52	2	
1	76	84	62	5	2	1	2	4	36	2	
2	76	31	119	5	2	1	1	0	40	2	
3	76	105	74	5	2	1	2	0	42	2	
4	67	126	128	5	2	1	2	1	29	1	
...	...	...	...	...	...	...	...	...	...	...	
1156	42	11	116	8	3	1	1	0	36	2	
1157	10	19	125	5	2	1	1	0	35	2	
1158	67	23	36	2	3	1	2	1	42	1	
1159	67	6	124	5	2	1	1	1	1	1	
1160	67	13	101	8	3	1	1	0	49	1	

1161 rows × 14 columns

```
y
```

```
0       2
1       2
2       1
3       0
4       2
       ..
1156    1
1157    2
1158    2
1159    2
1160    1
Name: classification, Length: 1161, dtype: int64
```

SPLIT INTO TRAIN AND TEST DATA

```
x=df1.drop('classification', axis=1)
y=df1[['classification']]
x_train, x_test, y_train,y_test = train_test_split(x,y,test_size=0.20, random_state = 7)
```

LOGISTIC REGRESSION

```
from sklearn.linear_model import LogisticRegression
model1=LogisticRegression()
model1.fit(x_train,y_train)
ypred1 = model1.predict(x_test)
print(ypred1)
```

```
[2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2]
```

```
print("Confussion matrix :\n",confusion_matrix(y_test,ypred1))
print("Classification report :\n",classification_report(y_test,ypred1))
print("TRAIN ACCURACY :",accuracy_score(y_train,model1.predict(x_train)))
print("TEST ACCURACY :",accuracy_score(y_test,ypred1))
```

```
Confussion matrix :
 [[  0   0  25]
 [  0   0  12]
 [  0   0 196]]
Classification report :
               precision    recall  f1-score   support

           0       0.00      0.00      0.00        25
           1       0.00      0.00      0.00        12
           2       0.84      1.00      0.91       196
```

```
    accuracy                           0.84       233
   macro avg       0.28      0.33      0.30       233
weighted avg       0.71      0.84      0.77       233

TRAIN ACCURACY : 0.834051724137931
TEST ACCURACY : 0.8412017167381974
```

K NEAREST NEIGHBOURS

```
model2 = neighbors.KNeighborsClassifier()
model2.fit(x_train,y_train)
ypred2 = model2.predict(x_test)
print(ypred2)
```

```
[2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 0 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 0 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2]
```

```
print("Confussion matrix :\n",confusion_matrix(y_test,ypred2))
print("Classification report :\n",classification_report(y_test,ypred2))
print("TRAIN ACCURACY :",accuracy_score(y_train,model2.predict(x_train)))
print("TEST ACCURACY :",accuracy_score(y_test,ypred2))
```

```
Confussion matrix :
 [[  0   0  25]
 [  0   0  12]
 [  4   1 191]]
Classification report :
               precision    recall  f1-score   support

           0       0.00      0.00      0.00        25
           1       0.00      0.00      0.00        12
           2       0.84      0.97      0.90       196

    accuracy                           0.82       233
   macro avg       0.28      0.32      0.30       233
weighted avg       0.70      0.82      0.76       233

TRAIN ACCURACY : 0.8448275862068966
TEST ACCURACY : 0.8197424892703863
```

RANDOM FOREST

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.datasets import make_classification
model3=RandomForestClassifier()
model3.fit(x_train,y_train)
ypred3 = model3.predict(x_test)
print(ypred3)
```

```
[0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 0 1 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 1 0 2 1 2 0 2 2 2 2 2 0 2 2 1 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 0 2 2 0 2 2 2 2 0 2
 2 2 0 2 2 2 2 0 2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2 2 0 0 2 2 2 2 2 2 2 2 2 2
 2 1 2 2 2 2 0 0 2 2 2 2 2 2 2 2 2 0 0 2 1 0 2 2 2 0 2 2 2 2 2 2 2 2 2 1 2
 2 2 2 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 0 2 1 2 2 2 2 2 0 2 2 2 2 2 1 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2]
```

```
print("Confussion matrix :\n",confusion_matrix(y_test,ypred3))
print("Classification report :\n",classification_report(y_test,ypred3))
print("TRAIN ACCURACY :",accuracy_score(y_train,model3.predict(x_train)))
print("TEST ACCURACY :",accuracy_score(y_test,ypred3))
```

```
Confussion matrix :
 [[ 25   0   0]
 [  0  12   0]
 [  0   0 196]]
Classification report :
               precision    recall  f1-score   support

           0       1.00      1.00      1.00        25
           1       1.00      1.00      1.00        12
           2       1.00      1.00      1.00       196
```

```
    accuracy                           1.00       233
   macro avg       1.00      1.00      1.00       233
weighted avg       1.00      1.00      1.00       233

TRAIN ACCURACY : 1.0
TEST ACCURACY : 1.0
```

DECISION TREE CLASSIFIER

```
from sklearn import tree
model4 = tree.DecisionTreeClassifier(criterion='entropy')
model4.fit(x_train,y_train)
ypred4 = model4.predict(x_test)
print(ypred4)
```

```
[0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 0 1 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 1 0 2 1 2 0 2 2 2 2 2 0 2 2 1 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 0 2 2 0 2 2 2 2 0 2
 2 2 0 2 2 2 2 0 2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2 2 0 0 2 2 2 2 2 2 2 2 2 2
 2 1 2 2 2 2 0 0 2 2 2 2 2 2 2 2 2 0 0 2 1 0 2 2 2 0 2 2 2 2 2 2 2 2 2 1 2
 2 2 2 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 0 2 1 2 2 2 2 2 0 2 2 2 2 2 1 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2]
```

```
print("Confussion matrix :\n",confusion_matrix(y_test,ypred4))
print("Classification report :\n",classification_report(y_test,ypred4))
print("TRAIN ACCURACY :",accuracy_score(y_train,model4.predict(x_train)))
print("TEST ACCURACY :",accuracy_score(y_test,ypred4))
```

```
Confussion matrix :
 [[ 25   0   0]
 [  0  12   0]
 [  0   0 196]]
Classification report :
               precision    recall  f1-score   support

           0       1.00      1.00      1.00        25
           1       1.00      1.00      1.00        12
           2       1.00      1.00      1.00       196

    accuracy                           1.00       233
   macro avg       1.00      1.00      1.00       233
weighted avg       1.00      1.00      1.00       233

TRAIN ACCURACY : 1.0
TEST ACCURACY : 1.0
```

NAIVE BAYES

```
from sklearn.naive_bayes import GaussianNB
model5 = GaussianNB()
model5.fit(x_train,y_train)
ypred5 = model5.predict(x_test)
print(ypred5)
```

```
[0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 0 1 2 2 1 2 2 0 2 2 2 2 2 2 2 2 2 1 0 2 1 2 0 2 2 2 2 2 0 2 2 1 2 2 2
 2 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 0 2 2 0 2 2 2 2 0 2
 2 2 0 2 2 2 2 0 2 2 0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 0 0 2 2 2 2 2 2 2 2 2 2
 2 1 2 2 2 2 0 0 2 2 2 2 2 2 2 2 2 0 0 2 1 0 2 2 2 0 2 2 2 2 2 2 2 2 2 0 2
 2 2 0 2 2 2 2 2 0 2 2 2 2 2 2 2 2 2 0 2 1 2 2 2 2 2 0 2 2 2 2 2 1 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2]
```

```
print("Confussion matrix :\n",confusion_matrix(y_test,ypred5))
print("Classification report :\n",classification_report(y_test,ypred5))
print("TRAIN ACCURACY :",accuracy_score(y_train,model5.predict(x_train)))
print("TEST ACCURACY :",accuracy_score(y_test,ypred5))
```

```
Confussion matrix :
 [[ 25   0   0]
 [  1  11   0]
 [  3   1 192]]
Classification report :
               precision    recall  f1-score   support

           0       0.86      1.00      0.93        25
           1       0.92      0.92      0.92        12
           2       1.00      0.98      0.99       196
```

```
    accuracy                           0.98       233
   macro avg       0.93      0.97      0.94       233
weighted avg       0.98      0.98      0.98       233

TRAIN ACCURACY : 0.96875
TEST ACCURACY : 0.9785407725321889
```

SUPPORT VECTOR MACHINES

```
from sklearn import svm
model6 = svm.SVC()
model6.fit(x_train,y_train)
ypred6 = model6.predict(x_test)
print(ypred6)
```

```
[2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2]
```

```
print("Confussion matrix :\n",confusion_matrix(y_test,ypred6))
print("Classification report :\n",classification_report(y_test,ypred6))
print("TRAIN ACCURACY :",accuracy_score(y_train,model6.predict(x_train)))
print("TEST ACCURACY :",accuracy_score(y_test,ypred6))
```

```
Confussion matrix :
 [[  0   0  25]
 [  0   0  12]
 [  0   0 196]]
Classification report :
               precision    recall  f1-score   support

           0       0.00      0.00      0.00        25
           1       0.00      0.00      0.00        12
           2       0.84      1.00      0.91       196

    accuracy                           0.84       233
   macro avg       0.28      0.33      0.30       233
weighted avg       0.71      0.84      0.77       233

TRAIN ACCURACY : 0.834051724137931
TEST ACCURACY : 0.8412017167381974
```

K MEANS CLUSTERING

```
from sklearn.cluster import KMeans
model7 = KMeans(n_clusters=3)
model7.fit(x_train,y_train)
ypred7 = model7.predict(x_test)
print(ypred7)
```

```
[0 2 0 1 1 0 0 2 2 2 1 0 2 1 1 2 0 0 2 0 2 1 1 2 0 2 1 1 2 0 0 2 2 2 1 0 0
 0 1 2 0 2 1 1 2 1 2 0 2 0 1 1 0 1 0 0 2 0 2 2 2 2 0 1 1 2 2 0 0 2 2 1 2 0
 2 2 1 0 2 1 2 1 0 0 0 2 2 1 2 1 1 2 1 2 2 1 0 1 1 2 0 2 1 1 2 2 2 1 1 2 1
 0 2 1 0 0 2 0 0 2 2 0 2 1 1 0 1 0 2 2 2 0 1 0 2 2 0 0 2 2 2 1 2 0 1 2 1 1
 1 1 2 2 2 2 2 1 2 1 2 1 0 0 2 1 1 1 0 1 0 0 1 0 1 1 0 2 1 0 0 1 1 2 2 0 1
 0 1 0 1 1 2 2 1 0 2 2 1 1 0 0 1 2 0 0 1 2 0 0 1 1 1 2 2 2 1 2 2 1 0 2 1 0
 0 1 1 1 2 0 2 0 0 1 0]
```

```
print("Confussion matrix :\n",confusion_matrix(y_test,ypred7))
print("Classification report :\n",classification_report(y_test,ypred7))
print("TRAIN ACCURACY :",accuracy_score(y_train,model7.predict(x_train)))
print("TEST ACCURACY :",accuracy_score(y_test,ypred7))
```

```
Confussion matrix :
 [[11  4 10]
 [ 4  3  5]
 [55 71 70]]
Classification report :
               precision    recall  f1-score   support

           0       0.16      0.44      0.23        25
           1       0.04      0.25      0.07        12
           2       0.82      0.36      0.50       196
```

```
    accuracy                           0.36       233
   macro avg       0.34      0.35      0.27       233
weighted avg       0.71      0.36      0.45       233

TRAIN ACCURACY : 0.3297413793103448
TEST ACCURACY : 0.3605150214592275
```

PREDICTION

```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from nltk.corpus import stopwords
from nltk.tokenize import WordPunctTokenizer
```

```
df2 = pd.read_csv('/content/restaurant_review_preprocessed_data.csv')
```

```
df2
```

1	U1077	P135038	Restaurant la Chalita	San Luis Potosi	San Luis Potosi	Mexico	2	4	Italian	2
2	U1077	P132825	puesto de tacos	San Luis	San Luis	Mexico	1	0	Latin American	6

```
import string
import re
def clean_reviews(reviews):
    reviews = reviews.translate(string.punctuation)

    ## Convert words to lower case and split them
    reviews = reviews.lower().split()

    ## Remove stop words
    stops = set(stopwords.words("english"))
    reviews = [w for w in reviews if not w in stops and len(w) >= 3]

    reviews = " ".join(reviews)

    # Clean the reviews
    reviews = re.sub(r"[^A-Za-z0-9^,!.\/'+-=]", " ", reviews)
    reviews = re.sub(r"what's", "what is ", reviews)
    reviews = re.sub(r"\'s", " ", reviews)
    reviews = re.sub(r"\'ve", " have ", reviews)
    reviews = re.sub(r"n't", " not ", reviews)
    reviews = re.sub(r"i'm", "i am ", reviews)
    reviews = re.sub(r"\'re", " are ", reviews)
    reviews = re.sub(r"\'d", " would ", reviews)
    reviews = re.sub(r"\'ll", " will ", reviews)
    reviews = re.sub(r",", " ", reviews)
    reviews = re.sub(r"\.", " ", reviews)
    reviews = re.sub(r"!", " ! ", reviews)
    reviews = re.sub(r"\/", " ", reviews)
    reviews = re.sub(r"\^", " ^ ", reviews)
    reviews = re.sub(r"\+", " + ", reviews)
    reviews = re.sub(r"\-", " - ", reviews)
    reviews = re.sub(r"\=", " = ", reviews)
    reviews = re.sub(r"'", " ", reviews)
    reviews = re.sub(r"(\d+)(k)", r"\g<1>000", reviews)
    reviews = re.sub(r":", " : ", reviews)
    reviews = re.sub(r" e g ", " eg ", reviews)
    reviews = re.sub(r" b g ", " bg ", reviews)
    reviews = re.sub(r" u s ", " american ", reviews)
    reviews = re.sub(r"\0s", "0", reviews)
    reviews = re.sub(r" 9 11 ", "911", reviews)
    reviews = re.sub(r"e - mail", "email", reviews)
    reviews = re.sub(r"j k", "jk", reviews)
    reviews = re.sub(r"\s{2,}", " ", reviews)
    return reviews
```

```
import nltk
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
True
```

```
yelp_data = df2[['user_id','place_id','reviews']]
yelp_data['reviews'] = yelp_data['reviews'].apply(clean_reviews)
```

```
userid_df = yelp_data[['user_id','reviews']]
placeid_df = yelp_data[['place_id', 'reviews']]
userid_df = userid_df.groupby('user_id').agg({'reviews': ' '.join})
placeid_df = placeid_df.groupby('place_id').agg({'reviews': ' '.join})
#userid vectorizer
userid_vectorizer = TfidfVectorizer(tokenizer = WordPunctTokenizer().tokenize, max_features=1000)
userid_vectors = userid_vectorizer.fit_transform(userid_df['reviews'])
userid_vectors.shape
#placeid vectorizer
placeid_vectorizer = TfidfVectorizer(tokenizer = WordPunctTokenizer().tokenize, max_features=1000)
placeid_vectors = placeid_vectorizer.fit_transform(placeid_df['reviews'])
placeid_vectors.shape
P = pd.DataFrame(userid_vectors.toarray(), index=userid_df.index, columns=userid_vectorizer.get_feature_names())
Q = pd.DataFrame(placeid_vectors.toarray(), index=placeid_df.index, columns=placeid_vectorizer.get_feature_names())
```

```
P.head()
```

	!	-	1	10	2	20	3	4	5	50	500	5service	9	:
user_id														
U1001	0.098002	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.000000	0.0	0.0	0.000000	0.000000	0.000000
U1002	0.103942	0.037683	0.000000	0.000000	0.000000	0.0	0.000000	0.256657	0.288510	0.0	0.0	0.000000	0.000000	0.050098
U1003	0.272206	0.065790	0.000000	0.064338	0.000000	0.0	0.000000	0.224047	0.604444	0.0	0.0	0.000000	0.000000	0.043733
U1004	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.189972	0.0	0.0	0.062422	0.000000	0.000000
U1005	0.117602	0.042635	0.038682	0.041694	0.095116	0.0	0.044256	0.000000	0.000000	0.0	0.0	0.000000	0.091577	0.198387

5 rows × 1000 columns

```
Q.head()
```

	!	-	1	10	2	20	3	4	5	50	500	5service	9	:	;	a	aam	able	absolute
place_id																			
P132560	0.044750	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.145019	0.0	0.0
P132561	0.035345	0.051889	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0
P132564	0.000000	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0
P132572	0.141395	0.041515	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0
P132583	0.000000	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.189013	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0

5 rows × 1000 columns

```
duplicate = df2[df2.duplicated()]
duplicate.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 0 entries
Data columns (total 15 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   user_id            0 non-null      object 
 1   place_id           0 non-null      object 
 2   restaurant_name    0 non-null      object 
 3   city               0 non-null      object 
 4   state              0 non-null      object 
 5   country            0 non-null      object 
 6   food_price         0 non-null      int64  
 7   smoking_area       0 non-null      int64  
 8   restaurant_cuisine  0 non-null      object 
 9   user_budget        0 non-null      int64  
 10  user_cuisine       0 non-null      object 
 11  reviews            0 non-null      object 
 12  classification     0 non-null      object 
 13  polaarity          0 non-null      float64
 14  subjectivity       0 non-null      float64
dtypes: float64(2), int64(3), object(10)
memory usage: 0.0+ bytes
```

```
userid_rating_matrix = pd.pivot_table(df2,values="polaarity",index=['user_id'],columns=['place_id'])
userid_rating_matrix.shape
```

```
(138, 130)
```

```
userid_rating_matrix
```

place_id	P132560	P132561	P132564	P132572	P132583	P132584	P132594	P132608	P132609	P132613	P132626	P132630	P132654	P
user_id														
U1001	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
U1002	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
U1003	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
U1004	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
U1005	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
U1134	NaN	NaN	NaN	0.664667	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
U1135	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
U1136	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
U1137	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	

```python
def matrix_factorization(R,P,Q,steps=100,gamma=0.001,lamda=0.02):
    for step in range(steps):
        for i in R.index:
            for j in R.columns:
                if R.loc[i,j]>0:
                    eij=R.loc[i,j]-np.dot(P.loc[i],Q.loc[j])
                    P.loc[i]=P.loc[i]+gamma*(eij*Q.loc[j]-lamda*P.loc[i])
                    Q.loc[j]=Q.loc[j]+gamma*(eij*P.loc[i]-lamda*Q.loc[j])
        e=0
        for i in R.index:
            for j in R.columns:
                if R.loc[i,j]>0:
                    e= e + pow(R.loc[i,j]-np.dot(P.loc[i],Q.loc[j]),2)+lamda*(pow(np.linalg.norm(P.loc[i]),2)+pow(np.linalg.norm(Q
        if e<0.001:
            break

    return P,Q
```

```python
P, Q = matrix_factorization(userid_rating_matrix, P, Q, steps=100, gamma=0.001,lamda=0.02)
```

```python
sentence = str(input())
test_df= pd.DataFrame([sentence], columns=['reviews'])
test_df['reviews'] = test_df['reviews'].apply(clean_reviews)
test_vectors = userid_vectorizer.transform(test_df['reviews'])
test_v_df = pd.DataFrame(test_vectors.toarray(), index=test_df.index, columns=userid_vectorizer.get_feature_names())
predict_item_rating=pd.DataFrame(np.dot(test_v_df.loc[0],Q.T),index=Q.index,columns=['polaarity'])
top_recommendations=pd.DataFrame.sort_values(predict_item_rating,['polaarity'],ascending=[0])[:10]
top_recommendations
```

```
EXCELLENT FOOD WITH PLEASANT ATMOSPHERE
```

	polaarity
place_id	
P135040	0.344398
P134999	0.221623
P132583	0.215803
P135033	0.187712
P134976	0.178318
P135011	0.178179
P135109	0.175426
P135038	0.150889
P135069	0.148240
P132572	0.145914